Perception of Weight Status and Frequency of Trying to Lose Weight among 8-15 Year-Olds (NHANES 2011-2012)

Plan B Paper

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I. Introduction

Misperception of body weight is defined as the discrepancy between an individual's actual body weight status and the subjective perception of their body weight status. Body weight misperception can lead to unhealthy eating or weight loss behaviors among children and adolescents, which over time can result in serious implications (Verzijl, Ahlich, Lang & Rancourt, 2018). Psychological outcomes in adolescents with inaccurate perception of weight status is an emerging area of research. Misperceptions of weight status have been linked to disordered eating occurrences (Verzijl, Ahlich, Lang & Rancourt, 2018). Understanding the extent to which weight status misperception is associated with certain dieting behaviors that may contribute to not meeting recommendations for dietary intake, overweight/obese or underweight status could help with prevention and treatment efforts in the adolescent population. Therefore, there is a need to better understand the relationship between misperceptions of weight status and dieting behaviors.

Guidelines have been set to classify weight categories among children, adolescents and adults. Body Mass Index (BMI) is a simple index of weight/height that has become an important measurement to classify overweight and obesity among adults (>20 years). BMI-for-age percentiles based on the CDC growth charts for children and adolescents (ages 2 through 19 years) are used to classify weight status of children and adolescents (Centers for Disease Control and Prevention, 2015) according to the following table:

Weight status	Adult categories	Child and adolescent categories
Underweight	BMI < 18.5 kg/m^2	$<5^{th}$ BMI percentile
Normal	BMI 18.5 - 24.9 kg/m^2	5^{th} to $< 85^{th}$ BMI percentile
Overweight	BMI 25.0 - 29.9 kg/m^2	85^{th} to $< 95^{th}$ BMI percentile
Obese	BMI > 30kg/m^2	$\geq 95^{th}$ BMI percentile

The current high prevalence of child and adolescent obesity and disparities based on race/ethnicity and socioeconomic status (SES) are major public health concerns. Ogden et al. (2018) reported that the prevalence of obesity for U.S. youth age 2-19 was 17.8% based on National Nutrition and Health Examination Survey (NNANES) data collected in 2015-2016. The prevalence was 5.8% for severe obesity (≥ 120% of the sex-specific 95^{th} percentile of CDC BMI-for-age growth charts). The prevalence of obesity was higher in 12-19 year olds (20.6%) compared to 6 to 11 year olds (17.9%) and 2 to 5 year olds (11.6%) based on NHANES data collected in 2007-2008 (Schwarz & Peterson, 2010). The prevalence of obesity was also higher in non-Hispanic Black (20.4%) and Hispanic (23.6%) youth compared to other racial groups (Schwarz & Peterson, 2010). Bauer, Marcus, Larson and Neumark-Sztainer (2017) found an association between the prevalence of obesity in a population-based sample of 2,706 students and SES of the household. SES was computed by an algorithm based on adolescent-reported parent education, eligibility for public assistance, eligibility for free or reduced school meals and parent employment. Adolescents from low and middle SES households had a higher likelihood of obesity (10.1% and 9.6%, respectively) compared to adolescents from high SES households (6.0%). Eighty percent of the children who were overweight at age ten to fifteen were also obese at the age of twenty-five (Whitaker et al., 1997).

The high prevalence of obesity can lead to dieting and unhealthy weight loss behaviors. Unhealthy or extreme weight loss is defined as the loss of 10 pounds or losing greater than 5% of one's body weight in less than twelve months (Robertson & Jameson, 2012). Unhealthy weight loss methods among college-aged students were described by Davila et al. (2014) and included fasting, eating very little food, taking diet pills, self-induced vomiting, using laxatives, using diuretics, skipping meals, and smoking cigarettes. In another study, unhealthy weight loss was associated with ambivalent feelings such as worry and guilt, which was related to a decreased quality of life (Kuijer & Boyce, 2014). Guilt functioned as both a motivator for behavioral change and also as an inhibitor for behavioral change centered around healthy eating. Feelings around food, along with weight loss practices were involved in defining healthy or unhealthy weight loss. Understanding the relationship between body weight misperception and weight loss efforts and practices as they relate to childhood and adolescent overweight and obesity is necessary.

The focus of this literature review was the examination of body weight misperception and weight loss efforts and practices as they related to food and nutrient intake among children and adolescents. Understanding the relationship between body weight misperception and the prevalence of weight loss efforts could offer healthcare providers new opportunities to educate and treat issues associated with unhealthy weight loss practices in childhood and adolescence. The correlation between body weight misperception and weight loss efforts warrant an exploration of body weight perception, dieting, and adolescent characteristics.

II. Literature Review

1. Body Weight Misperception

The relationship between body weight misperception and demographic and gender-oriented characteristics has been examined in several studies. Frayon et al. (2017) assessed misperception of weight status in adolescents living in the Pacific region. Gender did not significantly affect body weight misperception ($P = 0.571$). However, overweight and obese adolescent boys coming from low SES households (households with the reference person having a routine or manual occupation) were more likely to overestimate their weight status compared to high SES adolescents (coming from households with the reference person having a managerial or professional occupation). Another study examined weight control behaviors among adolescent sexual minorities (Hadland, Austin, Goodenow & Calzo, 2014). Data were obtained from 12,984 adolescents in grades 9-12 who participated in the Massachusetts Youth Risk Behavior Survey. One-third of adolescents in a sexual minority engaged in hazardous weight control behaviors. Both male and female adolescent sexual minorities who misperceived their own weight demonstrated increased likelihood of unhealthy weight-loss behaviors associated with eating disorders compared to heterosexual males and females. For example, 5.8% of the heterosexual females in the study used weight loss pills and products compared to 14.9% of lesbians and 15.8% of bisexual females. Another comparison showed that 6.4% of the heterosexual females reported vomiting or using laxatives to lose weight compared to 14.7% of lesbians and 17.8% of bisexual females. Gay males compared to heterosexual males were twice as likely to perceive themselves as underweight. Lesbian and bisexual females were more than twice as likely compared to heterosexual females to misperceive themselves as having a healthy weight or being underweight despite being overweight or obese (Hadland, Austin, Goodenow & Calzo 2014).

Sex differences in body weight misperception were reported among adolescents in two studies. In the first study, body weight misperception was assessed using pilot and baseline data including measured anthropometric and questionnaire data from a school-based intervention study by Wang, Liang and Chen (2009). This cross-sectional study involved 448 adolescents in grades 5 through 8 in Chicago Public Schools. Only 56.4% of male students with BMIs $\geq 85^{th}$ percentile considered themselves to be overweight or obese, whereas about two thirds (69.2%) of females $\geq 85^{th}$ BMI percentile considered themselves to be overweight or obese. However, only one quarter of the total participants reported body weight dissatisfaction. Additional gender-specific results regarding body weight misperception were reported in the second study by Jauregi-Lobera, Ezquerra-Cabrera, Cabonero-Carreno and Ruiz-Prieto (2013) based on survey data from 655 students from Seville with an average age of 16.2 years. About one-third (34%) of female students with a normal BMI misperceived themselves as being overweight, whereas 22.4% of males with a normal BMI misperceived themselves as being overweight. About two-thirds (63.8%) of participants who were underweight inaccurately perceived themselves as being normal weight. The findings from this study supported the body of literature indicating that self-perception above one's actual weight frequently occurs among youth.

Self-esteem and body satisfaction are attributes among obese adolescents that may be related to weight concern. A Project EAT participant sample of 2,706 students was used by Bauer, Marcus, Larson and Neumark-Sztainer (2017) to assess weight concern and body satisfaction. A smaller number of normal BMI individuals (3.9%) were concerned about their weight status compared to 6% with severe obesity (BMI percentile $\geq 120\%$). The authors also found that 18.3% of individuals with normal BMI reported having high self-esteem compared to 16.6% of those with a BMI indicative of severe obesity. Body satisfaction was also reported

among normal weight participants (47.4%) and those with severe obesity (34.4%). All of these results were significant ($P < 0.001$).

Several studies have also attempted to explain why youth have misperceptions of their body weight status. Rodgers, Wertheim, Damiano, Gregg and Paxton (2015) reported interview results from children aged 3 to 5 years regarding awareness of weight loss methods and stigmatization toward overweight status. The prevalence of dieting awareness jumped from 4.2% at age 3 to 27.8% at age 5 ($P < 0.001$). Awareness of eating healthy food as a weight loss method increased from 0.8% at age 3 to 8.9% at age 5 ($P < 0.0005$). Awareness of eating less as a weight loss method increased from 1.2% of 3 year olds to 8.9% of 5 year olds ($P < 0.0005$). Therefore, stigmatization of dieting and dieting awareness began at an early age. Interview responses also indicated adoption or awareness of stigmatizing attitudes toward overweight individuals to more than 15% of the children by the age of 5. Even at a young age, the "diet culture" was adopted and recognized by some children. Interviews were also conducted by other researchers with thirty-seven adolescent girls (11 – 19 years) to assess how young women negotiated feminine identities associated with dieting practices and their relationship with food, while also examining dieting activity and concerns about body appearance (Woolhouse, Day, Rickett & Milnes, 2011). Findings showed that culture around food and body image was important for the girls in the study. A slim and toned body was often seen as "ideal" for most cultures signifying health, beauty, accomplishment and being better off. Participants indicated that girls eat more "healthy" foods and boys eat more "junk" food. Positive findings were that participants had shifted their attitudes regarding previous beliefs that "no foods are sinful" and the recognition that thin body types do not necessarily look good. These changes in attitudes may result in less weight misperception and unhealthy dieting behaviors in today's society.

2. Body Weight Misperception and Negative Behaviors

Body weight perception was related to the occurrence of eating disturbances and other negative health outcomes. Espinoza, Penelo & Raich (2013) recorded perception of weight status in adolescents with eating disturbances thirty months after participation in a prevention program. Weight status misperception was decreased in the group that participated in the prevention program compared to the control group. These results are thought to be favorable as weight status misperception has been shown to be a predictor of disordered eating. However, the prevention program did not evaluate the influence of social support and self-esteem on the outcomes (Espinoza, Penelo & Raich, 2010). Winter, de Guia, Ferrence, and Cohen (2002) examined the number of young adults who smoked and the predominance of body dissatisfaction. The use of amphetamines for weight loss was positively associated with smoking among females but not males. Females who believed themselves to be overweight were greater than fifty percent more likely to be smokers compared to girls who perceived their weight to be of normal status or thin. Smoking, a particularly unhealthy weight-loss approach appeared to be stimulated by misperceived weight status in this study (Winter et al., 2002). In a study by Verzijl, Ahlich, Lang and Rancourt (2018), individuals ages 18 to 65 reported emotional eating in association with weight perception. Emotional eating was associated with having a high BMI (overweight and obese) among both accurate and under-perceivers ($P < 0.1$). The slope was greater for the group under-perceiving their weight status than those correctly perceiving their weight status (0.14 vs. 0.32). Higher BMI was associated with more uncontrolled eating ($P < 0.001$), along with inaccurate weight status perception ($P = 0.003$). Significant associations were also found in those with high BMIs and inaccurate weight status perception for restrained eating and the count of eating disorder symptoms.

More time spent watching TV was a negative behavior associated with trying to lose weight. Adolescent boys (grade 5-8) who were trying to lose weight actually spent more time watching TV than those who did not ($P < 0.05$) (Wang, Liang & Chen, 2009). Those who perceived themselves to be overweight were more likely to try to lose weight (OR = 5.88). No significant differences were observed in total energy intake or physical activity among participants trying to lose weight compared to those not trying to lose weight.

3. Body Weight Misperception and Dieting for Weight Loss

Several studies have examined the relationship between body weight misperception and frequency of dieting. For some of these studies, body image satisfaction was used in lieu of body weight perception. Body image satisfaction is generally defined as the liking of certain body appearances, whereas body weight perception is defined as the subjective perception of body weight status. Therefore, it is possible for individuals to perceive themselves as overweight but still feel positively about their body. It is important to acknowledge that individuals who accurately perceive themselves as overweight might be more likely to have some bias in self-reporting frequency of dieting and dietary intake compared to overweight individuals who misperceive their weight status as healthy.

A Body Image Satisfaction Questionnaire (BISQ) was used to examine various behaviors in dieters and non-dieters among 15-17-year-old Turkish adolescents (Canpolat, Orsel, Akdemir & Ozbay, 2005). Individuals assessed body parts on a subscale, which included body position, sport ability, body part ratio, body color, muscle power, height and weight. Low global self-worth was one factor associated with dieting in the female adolescent group. A high score on the physical appearance subscale of the Self-Perception Profile for Adolescents was also an indicator

related to dieting. The desire to have a thinner body ideal was predictive of dieting frequency ($P < 0.001$), and being underweight was inversely related to the frequency of dieting ($P = 0.04$). Further results from the study showed that scores on the BISQ in the non-dieting group were different from the frequent/sometimes dieting group. The authors suggested that perceived weight and wishing to be thinner may have had stronger effects on body satisfaction than measured BMIs that indicated overweight/obesity. These results are consistent with a study by Gruber, Pope, Lalonde and Hudson (2001). Seventy-seven college-aged women at Harvard University were recruited for a study on body image. Dieters in the study had a higher level of body dissatisfaction than non-dieters with a 6.0% greater difference in perceived and ideal bodies ($P < 0.001$). After adjusting for measured body fat, dieters still exceeded non-dieters by an average of 4.6% on body dissatisfaction ($P = 0.002$). After adjusting for measured body fat, a dieting women with 17.5% body fat experienced the same amount of body dissatisfaction as a non-dieting women with a body fat percentage of 30. In a study by Kosic and Pokrajac-Bulian (2014), adolescent girls were followed from fifth grade throughout high school to assess body image. Body dissatisfaction and social comparison were the main predictors of dieting in female students. This study found that increasing age and correct body weight perception were both important regulators to prevent extreme dieting (an extreme weight control behavior). In a related study on body weight misperception and dieting, Epperson et al. (2014) examined data from the Healthy Passages study, Wave I. The sample consisted of students in fifth grade, with 5,147 children completing the assessment. Negative body weight perception was positively associated with weight loss attempts ($P < .05$). This study showed a correlation between weight perception and weight loss attempts, however no association was observed with unhealthy weight loss, future complications, and weight-related disease. Previous research has also

indicated that a negative body weight perception was associated with a higher proportion of high school students dieting (Neumark-Sztainer et al. 2006). About half of the males (46.2%) with negative body satisfaction dieted compared to 18.4% with positive body satisfaction. About two-thirds of females (65.1%) with negative body satisfaction dieted compared to 47.1% with positive body satisfaction. Body satisfaction was assessed using a version of the Body Shape Satisfaction Scale. Likert responses were used to generate scores for how satisfied an individual was with different body parts.

Other studies have also assessed weight perception and weight loss behaviors among male and female adolescents. Sonneville, Thurston, Milliren, Gooding and Richmond (2016) found greater use of performance-enhancing products and substances among males who under-perceived their weight compared to those with normal or over-perceived weight (OR = 2.06). This association was also seen for females who under-perceived their weight status (OR = 2.29). Females who misperceived their weight as being healthy were less likely to fast and skip meals (OR = 0.25), engage in vomiting, and take diet pills/laxatives as a means of changing weight status (OR = 0.10). Similar results were found for the males in the study. Those perceiving weight status to be healthy engaged in less fasting and skipping meals (OR = 0.31) and were less likely to engage in vomiting, and taking diet pills/laxatives as a means of changing weight status (OR = 0.10). Many similarities were found in weight perception and associated reported weight control methods between males and females. Contreras et al. (2014) assessed body dissatisfaction in dieting girls. Adolescents that were ages twelve to nineteen (n = 439) were sampled from the Eating Disorders Inventory-2. The group of adolescents that were most likely to have restrictive diets and purging behaviors included adolescents who perceived themselves to

be overweight and obese. The dieting groups of girls had higher levels of body dissatisfaction and thinness obsession compared to a non-dieting group of girls.

Weight loss behaviors in association with body image were examined in several national samples of adolescents. Data from the National Longitudinal Study of Adolescent Health (Wave I) showed that girls with body image overestimation were 4.3 times more likely to have onset of extreme weight loss behavior within one year, compared to girls without body image overestimation (Liechty, 2010). Girls who engaged in prior dieting were three times more likely to engage in future dieting when compared to girls who did not diet at all. In addition, compulsive exercise motivated by external appearance was correlated with poor body image, whereas exercise motivated by enjoyment and health was not correlated with poor body image. This comprehensive study showed multiple connections with body image and extreme weight loss behaviors. Yost, Krainovich-Miller, Budin and Norman (2010) analyzed nationally representative data from 2,510 U.S. adolescent girls from Wave II of the National Longitudinal Study of Adolescent Health. Those who perceived themselves as overweight were thirteen to twenty-five times more likely to try to lose weight than those who did not perceive themselves as overweight. Overweight and obese participants were 2-4 times more likely to try to lose weight compared to participants who were not overweight or obese. Among the 47% who were trying to lose weight, 80% reported including exercise as a weight loss method. BMI and weight perception accuracy were not associated with the increased odds of using exercise as a weight loss method. Chen et. al. (2014) examined weight perception in a nationally representative sample of 8-15-year-old adolescents and weight loss attempts using data from 2,613 participants (NHANES 2007-2010). About one fourth of adolescents (27.3%) underestimated their weight status and 2.8% overestimated their weight status. Overweight adolescents in grades nine

through twelve who had accurate weight perception were more likely to report engaging in positive weight-related behaviors than those who misperceived their weight status (over or under perception of weight status). This study established that accurate weight status perception was a significant factor for healthy weight loss behavior and that accurate weight perception was important in maintaining a healthy weight and reducing risk factors for eating disorders and obesity. The odds of weight-loss attempts were 10 times higher among healthy weight participants who overestimated actual body weight status compared to those who accurately perceived their body weight status.

Weight perceptions and frequency of dieting have been studied in other countries in addition to the U.S. For example, a cross-sectional sample of 1,874 girls in South India participated in a study by Duncan, Duncan and Schofield (2010) regarding body weight perception and dieting. The perception of weight status was the greatest indicator of whether girls would diet. Girls who misdiagnosed themselves as overweight were three or more times likely to diet than those who perceived themselves to be underweight. Girls in all ethnic groups who were attempting to lose weight often did so through a combination of dieting and exercising. Females who were of BMI status >85th percentile reported exercising as a means of losing weight significantly more than females in other BMI percentile categories (OR = 1.57). Overweight and obese weight status perception also led to an increase in exercise for weight loss in girls (OR = 2.52). This study showed that the ability to accurately assess weight status contributed to choosing healthy weight loss behaviors and avoiding extreme or harmful behaviors. Weight status was an important factor related to dieting among samples of adolescents in over 30 countries. Ojala et al. (2007) examined data from the Health Behaviour in School-aged Children Survey (2001/2002) to determine the likelihood of attempts to lose weight. In both

gender groups in all countries, the frequency of weight loss attempts was significantly higher for overweight adolescents than non-overweight adolescents. For example, in Austria, 7% of non-overweight boys were trying to lose weight compared to 27% of overweight boys. Similar patterns were observed in adolescent girls in Austria with 16% of non-overweight girls trying to lose weight and 39% of overweight girls trying to lose weight. Exercising (range 71% to 97%) and eating fewer sweets (28 - 100%) were the most common weight loss methods for both sexes in all countries except for Latvia. Across seven countries, overweight boys and girls generally reported eating fewer sweets, drinking fewer soft drinks and dieting under the supervision of health care professionals as a means to lose weight more than non-overweight individuals.

4. Weight Misperception and Weight Loss Methods

A number of studies have examined the relationship between weight misperception and dieting in addition to reporting the types of weight loss methods used. Bauer, Laska, Fulkerson and Neumark-Sztainer (2010) evaluated parental encouragement for dieting among Project EAT participants in middle school (1999) and after a follow up period (2004). Male and female students reported significantly less parental encouragement to eat healthy food ($P = 0.03$), to be physically active ($P < 0.001$), and to diet to control weight ($P = 0.02$) between early and middle adolescence in the transition from middle to high school which may have an effect on dieting outcomes in adolescents. Yang, Turk, Allison, James and Chasens (2014) analyzed data from the National Health and Nutrition Examination Survey (NHANES 2009-2010). Among overweight or obese adolescents, there was a significant relationship between accurate weight perception and weight-loss efforts ($P < 0.01$). For those who were obese or overweight, 22% considered themselves to be normal weight, whereas for adolescents who were underweight (3% of the

study population), 67% perceived themselves to be normal weight and 26% considered themselves to be overweight. Eating less (71.7%) was the most frequently reported weight loss method. Other weight loss methods observed in this study included eating less fat (23.7%), eating fewer sweets (23.0%), consuming less junk food (29.0%), consuming fewer carbohydrates (4.6%), consuming more fruits and vegetables (32.9%) and fewer calories per day (19.1%), and being on a liquid diet formula (11.2%). Another study using NHANES data (2005-2010) took into account how body misperception would affect eating behaviors among children 8 to 15 years of age. Chung, Perrin, and Skinner (2013) observed the proportion of children and adolescents who reported various weight loss methods by age, sex and accuracy of perception of overweight. Girls (8-11 years) reported starving ($P = 0.001$), cutting back on eating ($P = 0.001$), and often skipping meals ($P = < 0.0001$) less than boys (8-11 years). In adolescents aged 12-15, girls reported cutting back on eating more than boys ($P = 0.028$). A significantly higher proportion of girls 12-15 years who accurately perceived their overweight status reported cutting back, skipping meals, and exercising as means of weight loss compared to those inaccurately perceived themselves as overweight. A significantly higher proportion of boys 12-15 years who accurately perceived their overweight status reported dieting, cutting back, skipping meals, and exercising as means of weight loss compared to those inaccurately perceived themselves as overweight.

Two studies used data from the Youth Risk Behavior Survey to assess weight management practices among adolescents. Paxton, Valois, and Drane (2004) assessed weight management practices in an adolescent population with body weight misperception using the CDC Youth Risk Behavior Survey in public high schools in South Carolina. In this sample of adolescents (n = 3,089), only 13.4% were overweight, however, 41.7% were trying to lose

weight. Of this population, 58.8% reported that they exercised to lose weight, 37.9% ate fewer calories, 13.6% went without eating for twenty-four hours or more, 7.9% took diet pills, powders or liquids, and 5.8% vomited or used laxatives to lose weight. One in four of the students who were trying to lose weight reported using unhealthy weight control behaviors such as fasting, using diet pills, or vomiting. Fan and Jin (2015) reported results from the Youth Risk Behavior Surveillance Survey based on a nationally representative sample of ninth through twelfth grade students in the U.S. The data were collected from 50,421 adolescents during 2001-2009. Adolescents with overweight perception engaged in extreme weight-loss methods to gain immediate gratification, especially when those adolescents were of normal weight (9–11% fasted, 6–10% followed unguided diets). Self-perception of being overweight increased weight loss intentions by 20 percentage points for females and 37 percentage points for males. While healthy diets and exercise habits should be the goal, the results from this study suggest that the opposite happens with adolescents who have weight misperception.

Several studies were conducted with participants in countries other than the U.S. to identify weight loss methods used by adolescents. Paxton et al. (1991) reported the use of diet and weight loss methods in high school students located in the Melbourne area. Adolescent girls reported greater use of crash diets ($P < 0.0005$), calorie counting ($P < 0.0005$), meal skipping ($P < 0.0005$), drinking water ($P < 0.0005$), and not eating between meals to lose weight ($P < 0.0005$) compared to boys. Exercise was the most commonly reported weight loss method for both boys (81.6%) and girls (82.7%). Drinking lots of water to lose weight was the next most frequently reported method (38.9% girls, 28.0% boys). Smoking in youth was also used to control weight (3.3%). Of those in the sample, 47.9% of girls and 26% of the boys reported using at least one extreme weight-loss behavior. Interestingly, 13.2% of the girls and 8.8% of the boys

in this study engaged in a weight loss method every week. Subjects were also asked where they obtained information on diet and health. Girls most often reported finding information in magazines, listening to their parents, school, television and friends; whereas boys reported that their parents were their primary source, followed by the other sources. Quick et al. (2013) assessed body image and weight loss methods among adolescents from twenty-four different countries. From this cross-sectional study, data were collected at 3 waves from the same individuals (2001/2002, 2005/2006, 2009/2010). Overweight adolescent girls were more likely to underestimate their body size over time (from 13 to 19%). In general, overweight adolescent girls were more likely to underestimate body size compared to girls with a normal or underweight BMI (OR = 1.68). Consistent with this result, overweight adolescent boys were also more likely to underestimate body size compared to normal and underweight boys (OR = 1.10). Dieting for weight loss decreased among the three time periods for girls from 87% to 40%, whereas dieting for weight loss increased among the three time periods for boys slightly from 23% to 25%. Underestimation in overweight individuals could be detrimental because these individuals may not see the need for dietary and lifestyle changes.

Other studies examined weight loss methods and described results by sex, whereas several described differences in weight loss methods used by sex. McCabe and Ricciardelli (2005) explored different weight loss methods and reasons for using these methods in adolescents with incorrect body image perception (girls n = 246, boys n = 344) over a 16 month period. Girls with body misperception tended to engage in weight loss methods and extreme weight loss methods ($P < 0.001$), while boys tended to engage in strategies to increase muscle ($P < 0.05$), such as exercise. For girls, social pressures from friends and family members along with the media were the driving forces, whereas the media was the driving force for boys. Moreover,

body misperception led to more weight loss efforts, which could be dangerous if weight loss was detrimental or unsafe for the individual. The authors suggested that a change in the perceived messages might allow healthier behaviors in adolescent dieting. Moy, Petric, Dockendorff, Greenleaf and Martin (2013) surveyed 669 middle school boys and 708 girls with an average age of 12 to examine weight loss efforts including dieting and exercise in relation to intuitive eating. Dieters felt that they had less permission to eat what they wanted, when they wanted it and were more likely to eat for emotional reasons than for physiological hunger responses ($P < 0.05$). Sex differences existed in this study with adolescent girls being more aware of their hunger cues and satiety compared to adolescent boys ($F = 13.85$). Regardless of sex and dieting status, adolescents who were exercising to manage weight reported feeling less free to eat what and when they wanted, but also were more likely to eat for hunger over emotional response. Jonason, Krcmar, & Sohn (2009) surveyed 206 males (mean age = 20 years) at a large university in the Northeastern region of the U.S. to assess men's body satisfaction in relation to weight loss methods. Results indicated that higher measured BMI, social comparison, and exposure to muscular media all significantly reduced body satisfaction in males (P values < 0.01). Indications of differences in how females and males arrive at body satisfaction was studied by McCabe & Ricciardelli (2004). The sample was comprised of 430 boys and 451 girls in grades 7-9. Results indicated that girls were more likely to try to lose weight and engage in disordered eating compared to boys to decrease body dissatisfaction ($P < 0.01$). Use of food supplements, steroids, and ways of increasing muscle mass was reported as higher in boys than girls ($P < 0.01$). Overall, adolescents used strategies that change body shape to try to fit into society's view of an "ideal body for boys and girls".

5. Dieting to Lose Weight and Food Group and Nutrient Intakes

Several studies have examined relationships between dieting status among youth and dietary intake including food groups and meals. In a study by Nystrom, Schmitz, Perry, Lytle and Neumark-Sztainer (2004), data from the Teens Eating for Energy and Nutrition at School showed that fruit and vegetable intakes were associated with weight loss efforts and current weight status. Boys who perceived themselves to be underweight consumed 0.8 fewer servings of fruits and vegetables per day than boys who perceived themselves to be about the right weight ($P = 0.002$). Girls and boys who perceived themselves as overweight compared to those who perceived themselves as about the right weight consumed 0.6 fewer servings ($P = 0.005$) and 0.7 fewer servings ($P = 0.02$), respectively. Boys who wanted to lose or gain weight also had a significantly higher intake of fruits and vegetables compared to boys not wanting to do anything about their weight status (mean 0.8 - 1.0 more servings per day). Girls engaging in weight-related behaviors consumed 0.7 more servings of fruit and vegetables per day than girls not engaging in weight-related behaviors ($P = 0.006$). Burke et al. (2006) examined dietary intakes in overweight and obese Australian adolescents. Vegetable intake was associated with lower risks of being overweight and obese in adolescent boys (OR = 0.98). Overall, girls consumed fewer soft drinks ($P < 0.0001$), vegetables ($P < 0.01$) and fruit ($P < 0.01$) compared to boys over all the age groups. Nuvoli (2015) studied those aged 7-90 years old from Sardinia, Italy by examining breakfast, lunch and dinner components, body weight and use of diet and exercise. Children (age 7-11) had significantly higher intakes of mid-morning snacks compared to seniors, with 44.4% of children having midmorning snacks 7 times a week compared to 8.7% of seniors ($P < 0.001$). Body weight misperception was also observed. Of the children in the study, 79% had normal weight status. However only 57.4% of the total sample perceived themselves to be

normal weight. Under and overweight misperceptions were reported. Total underweight misperception reported was 24.1%, and total overweight body misperception was 18.5%. Kant and Graubard (2003) reported consumption of foods based on a 24-hour dietary recall by a nationally-representative sample of 8-16-year-old U.S. children and adolescents (NHANES 1988 - 1994). Intake of low-nutrient-density foods by males and females was associated with energy intake, number of eating occasions reported, and intakes of nutrient-dense foods from the five food groups ($P = 0.0001$), but not with the frequency of trying to lose weight in the last 12 months. Van Vliet, Gustafsson and Nelson (2016) conducted a study with Swedish adolescents ages 7 to 17 to understand associations between body weight perceptions and unhealthy eating habits. Feeling the need to lose weight was higher for girls in the study than boys ($P < 0.01$). Feeling the need to lose weight was higher among boys and girls with perception of overweight status ($P < 0.01$). BMI was negatively correlated with consumption of vegetables ($P < 0.05$) and positively correlated with consumption of sugary drinks ($P < 0.01$).

Food choice criteria and food intake patterns among adolescents were examined in several studies. Contento, Williams, Michela and Franklin (2006) asked adolescents (11-18 years old) about their food choices in relation to family and friends. The top criteria for food choice was taste (59%) followed by familiarity or habit (19%). Other criteria included whether the food was filling, health reasons and dieting concerns. When choosing a beverage adolescents opted for the healthier options with 62 of the 76 adolescents reporting that they choose juice or milk over sugar-sweetened beverages. Lattimore and Halford (2003) accessed food consumption patterns of 11 to 16 year olds. Sex differences in dieting frequency were observed ($P < 0.0005$). The number of males dieting to either maintain or lose weight was 18% compared to 35% for females. Females (n = 132) were more likely to report skipping breakfast compared to males (n =

64). Females dieting to lose weight had lower intakes of sugar, fat, snack-foods, and sodium than female non-dieters. Conento, Michela and Williams (1995) compared food and nutrient intake by dieting status. Those who dieted were more likely to eat foods that they believed to be healthy and contain vitamins and minerals and to avoid food high in sugar compared to those not dieting. Gabhaiin, Nolan, Kelleher and Friel (2001) identified differences in food habits by dieting status among 9-17 year olds in Ireland. For both boys and girls, dieters reported lower intakes of sweets, cakes, pastries, and potato crisps, and greater high-fat milk consumption compared to non-dieters. The percentage of dieters exercising 4+ times a week was 52% for those age 9-11 compared to 72% for those not dieting ($P < 0.001$). Similar trends were found in exercise frequency between dieters and non-dieters in all other age groups. Oellingrath, Hestetun and Svendsen (2015) examined associations between weight perception and satisfaction with appearance with slimming attempts and eating patterns among 469 Norwegian adolescents (mean age = 12.7 years) by sex. Male and female adolescents who perceived themselves as overweight were more likely to engage in slimming attempts than those who perceived their body weight status to be of normal weight. In girls, low satisfaction with appearance was associated with slimming attempts and a high score on the dieting eating pattern. Girls who reported slimming attempts generally adhered to a low-fat, low-sugar eating pattern. Barr (2007) investigated whether calcium intake was associated with body fat in 45 peripubertal girls (average age of 10.5 years) over 2 years. Girls who were concerned about body weight or shape tended to avoid high calcium foods. Girls with a mean calcium intake below baseline levels had significantly higher body fat percentages ($P < 0.01$). Dietary intake based on Youth Risk Behavior Survey data was compared with weight perception of 9^{th}-12^{th} graders by Dues, Kandiah, Khubchandani (2019). Females were more likely to overestimate weight status

compared to males (17% vs. 5.8%), whereas, males were more likely to underestimate weight status compared to females (16% vs. 6.9%). Females with a normal BMI with weight misperception had higher odds of trying to lose weight (AOR=12.60), lower odds for eating fruit (AOR=0.52), and lower odds for drinking milk (AOR=0.81). Males who had a normal BMI with weight misperception had lower odds of drinking fruit juice (AOR=0.54) and eating breakfast (AOR=0.65).

Researchers conducting several studies based on Project EAT data from junior and senior high school students in the Twin Cities area reported associations between weight control behaviors and dietary intake. Larson, Neumark-Sztainer and Story (2009) described patterns of weight control behaviors indicating that persisting to use weight control behaviors over five years was associated with lower intakes of energy, fiber, vegetables, whole-grains, saturated fat, calcium, iron, fruit, snack-foods and sugar-sweetened beverage drinks. However, no association was observed between persisting to use weight control behaviors and protein intake ($P = 0.34$). In a ten-year follow up study of Project EAT by Neumark-Sztainer, Wall, Larson, Eisenberg and Loth (2011), data from participants with a mean age of 14.5 were examined for weight control changes. The prevalence of dieting among boys increased significantly from 21.9% to 34.5% throughout the ten years. However, the prevalence of dieting among girls remained at a higher rate throughout the follow-up period at a constant rate of 57.5% to 59%. Unhealthy diet behaviors in girls increased from 8.4% to 20.4% while the increase observed among boys was not as large (2.1% to 7.3%). Unhealthy dieting methods included use of laxatives, diet pills, fad diets, over exercising, and fasting and skipping meals. Neumark-Sztainer, Hannan, Story and Perry (2004) reported findings from ethnically-diverse adolescents from middle and high schools who had participated in the Project EAT study. Girls who used unhealthful weight-control

behaviors reported lower intakes of vegetables, fruit, energy, grains, snack foods, total fat, protein, carbohydrates, calcium, iron, vitamin A, vitamin C, vitamin B-6, folate and zinc compared to girls using only healthful weight-control behaviors. Calcium intake for girls using healthy weight control behaviors on average was 1,132 mg versus 974 mg in the group using unhealthy weight control behaviors ($P < 0.001$). In comparison, boys who reported using unhealthful weight-control behaviors reported lower intakes of fruits, snack foods, total fat, and saturated fat. Dietary intakes differed between use of healthy and unhealthy weight control behaviors and between sexes.

Two studies involving Canadian adolescents reported associations between body weight concern, dieting and food intake. Woodruff, Hanning, Lambraki, Storey and McCargar (2008) examined weight concerns among 9th and 10th graders. Of those who were dieting or concerned about their weight status, 61% had a healthy weight. Of those not dieting or concerned about weight, 13% were overweight or obese. In the dieting groups of boys and girls, higher diet quality was reported ($P < 0.001$). In another study by Woodruff and Hanning (2009) relationships between meal frequency and food behaviors along with attitudes were assessed among adolescents in the Ontario area in sixth, seventh and eighth grade. Family dinner frequency was negatively associated with soft drink consumption ($P < 0.001$), fast food frequency consumption ($P < 0.05$) and dieting frequency ($P < 0.001$). Family meals may be occasions where parents can teach children about the importance of healthy food behaviors.

III. Conclusions and Purpose of the Research Report

Overall, this review of the literature showed associations between body weight misperception and weight loss patterns and methods. Notably, when correct weight perception

was observed in a population, a lower rate of dieting was observed compared to those with a misperception of weight status. The research also showed that overweight and obese individuals were more likely to engage in risky weight loss behaviors due to body image status and body weight perception. While weight loss methods were numerous, exercise was the most common method reported. Fasting and/or dieting were the next most common practices reported. Overall, the results showed that regardless of current weight status, body weight misperception was positively correlated with weight loss patterns and methods.

Several limitations could affect the interpretation of results from studies on the perception of weight status as it relates to weight loss patterns and methods in adolescents. Limitations include self-reporting studies, ecological fallacy, and limited data on the weight loss methods used by individuals.

The relationship between dieting and food and nutrient intakes needs to be examined further based on the negative consequences reported for dieting behaviors among youth. Therefore, the purpose of this Plan B research study was to describe the characteristics of children (8-11 years) and adolescents (12-15 years) by past year report of trying to lose weight and to determine differences in food groups and nutrient intakes by report of trying to lose weight.

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Title: Food Group and Nutrient Intake by Reported Frequency of Trying to Lose Weight Among 8-15 year olds (NHANES 2011-2012)

Introduction

The prevalence of obesity among youth (2-19 years old) was 18.5% in the United States (U.S.) based on National Health and Nutrition Examination Survey (NHANES) data collected in 2015 – 2016.[1] For all children 2 – 19 years, the prevalence of obesity was 19.1% among boys and 17.8% among girls. The prevalence of obesity was higher among certain racial/ethnic groups for all children 2 – 19 years (2015 – 2016).[2] Among Hispanic youth, the obesity rate was 25.8%, while in non-Hispanic Black, non-Hispanic White, and non-Hispanic Asian youth, the rate was 22.0%, 14.1%, and 11.0%, respectively.[2] Youth (2 – 19 years) in households with incomes ≤ 130% of the federal poverty level had an obesity rate of 18.9% whereas youth in households with incomes > 350% of the poverty level had an obesity rate of 10.9% based on NHANES data (2011- 2014).[3] Obesity in youth is a public health concern in the United States, especially for low-income minority youth.

The current prevalence of child and adolescent obesity is higher than the U.S. Healthy People 2020 target goal of ≤ 14.5%.[4] Obesity has been linked to negative health outcomes among adolescents including hypertension and hyperlipidemia.[5] High BMI leads to increased risk of cardiovascular disease, diabetes, increased oxidative stress, chronic kidney disease and cancers.[5] A high BMI also leads to more years lived with a disability. Severe obesity in adolescents ages 2 to 19 has risen from 1999 - 2004 (4%) to 2013 - 2014 (> 8%).[5] The increasing prevalence of overweight and obesity in children can be attributed to a multitude of factors, including being able to accurately perceive weight status.

Several studies have shown that a number of children and adolescents do not accurately perceive whether they are overweight.[6] According to NHANES (2005 – 2012), 30% of children and adolescents (8-15 years) misperceived their weight status.[6] A high percentage of obese boys

(48%) and girls (36%) considered themselves to be normal weight. In households with a lower annual income, weight misperception was observed to a greater extent than among children and adolescents from higher income households. Frayon et al. (2017) found that misperception of weight status was associated with socioeconomic status (SES). Overweight and obese adolescent boys coming from low SES households (households with the reference person having a routine or manual occupation) compared to high SES adolescents (coming from households with the reference person having a managerial or professional occupation) were more likely to overestimate their weight status.[7] A study conducted in rural communities found that 51.7% of African American overweight participants perceived themselves to be normal weight, while 36.4% of overweight White participants perceived themselves to be normal weight.[8] Weight misperception was more common among non-Hispanic Black (34.4%) and Mexican-American (34%) children and adolescents compared to non-Hispanic White youth (27.7%).[6] In a cross-sectional study involving adolescents from the Netherlands, a strong association was observed between family income, mother's level of education and weight perception ($p < 0.001$).[9] Accuracy of weight perception improved as the level of mother's education increased from 75.4% for adolescents with mothers with a low level of education to 84.4% for those with a middle level of education, and 88.5% for those with highly educated mothers.[9] In another study regarding body image perceptions and disturbed eating in Germany, most German adolescents (11 – 17 years) underestimated the average female body size (88.1%) on the photographic figure rating scale, while 3.8% showed bias in overestimation of body weight in the photos.[10] Only 8.1% accurately estimated the average female body size. The mean score of participants (both girl and boys) on the photographic figure scale was 2.7, corresponding to a BMI of 20.0, whereas the average BMI in Germany in 2013 was 22.4.[10]

Dieting as a child or adolescent may have adverse long term effects. Project EAT (Eating Among Teens population study) data were used to examine food and nutrient intakes of youth at two time points based on whether they engaged in unhealthful weight control behaviors.[11] The average energy intake per day was 1,904 kilocalories for youth who never engaged in unhealthful weight control behaviors and 1,771 kilocalories per day for those who engaged in unhealthful weight control behaviors throughout the study.[11] Significant differences were observed between those who engaged or never engaged in unhealthful weight control behaviors for intakes of iron ($p=0.009$), snack foods ($p=0.05$) and sugar-sweetened beverages ($p=0.02$). Fiber, vegetables, fruit, whole grain and calcium intakes were higher in the group that never engaged in unhealthful weight control and dieting behaviors compared to those who engaged in these behaviors throughout the study. In another Project EAT study, food and nutrient intakes among middle and high school students from Minneapolis/ St. Paul public schools from diverse backgrounds were compared by use of unhealthful versus healthful weight-control behaviors.[12] Girls who reported using unhealthful weight control behaviors such as dieting and using laxatives had lower intakes of fruits, vegetables, calcium, iron, and grains compared to girls who used healthy behaviors, however this association was not observed among boys.[12] Therefore, sex may play a role in adequate nutrient consumption while using weight-control behaviors. Another finding was that boys using unhealthful weight-control behaviors had higher intakes of fruit ($p=0.002$) compared to boys not using weight-control behaviors.[12] Examination of adolescent food patterns by use of unhealthy practices (dieting) and healthy practices (lifestyle) may provide insight into benefits and adverse consequences of dieting.

Associations between dieting and concern about one's body weight have been observed.[13] In a study involving students ages 13 - 17 in Ontario and Alberta, food behavior questionnaire

data showed that among participants with a normal BMI, 26% were dieting or were concerned about their weight.[13] For participants who were overweight or obese, 59% were dieting or were concerned about their weight status. Researchers conducted a Project EAT 10-year follow up study (1999-2010) in the Minneapolis/St. Paul area of adolescence through young adulthood to determine if the prevalence of dieting behaviors continued into young adulthood.[14] Girls reported increased use of extreme weight loss control behaviors from early adolescence to early young adulthood (8.4% to 20.4%) and from middle adolescence to middle young adulthood (12.6% to 20.6%).[14] However among boys, a significant increase in extreme weight control behaviors was reported from middle adolescence (2.1%) to middle young adulthood (7.3%).[14] Use of diet pills increased among both boys and girls from young adolescence to young adulthood, whereas laxative use only increased among girls over time (1.3% to 4.8%). Overall, these data showed that girls and boys who dieted in adolescence were more likely to diet in young adulthood.

The relationship between dieting and food and nutrient intakes needs to be examined further based on misperceptions of weight status and disparities by ethnicity/race and household income, and the negative consequences reported for dieting behaviors among youth. Therefore, the purpose of this study was to describe the characteristics of children (8-11 years) and adolescents (12-15 years) by the frequency of trying to lose weight and to determine differences in food groups and nutrient intakes by the frequency of trying to lose weight.

Methods

The study sample included participants aged 8 – 15 years from the 2011-2012 NHANES. The most recent 2-year NHANES data collection cycle that collected in-depth Youth Weight History data was 2011-2012. Children and adolescents ages 8-15 were asked to complete the

Youth Weight History Questionnaire, whereas those 16-59 years were asked to complete a different Weight History Questionnaire. Details about the study design, sampling method, and instruments are included in the 2011-2012 Survey Operations Manuals on the Centers for Disease Control and Prevention (CDCP) NHANES website.[15] For this study, participants were included if they had measured weight and height, and information on self-perception of weight, weight-loss efforts and methods, and health-related behaviors (n = 1303).

Sociodemographic variables

Initial family and youth demographic questions were asked in the home by trained interviewers. Sociodemographic information included sex, age, ethnicity (non-Hispanic White, non-Hispanic Black, Mexican American and Hispanic, and other), family income level, and parent's education level. Annual family income level was determined by a ratio of family income to poverty threshold and was recoded into two levels (≤ $34,999, ≥ $35,000). Level of education for the household reference person was collapsed from eight into two levels for analysis (High School Grad/GED or equivalent, some College/College Grad/Graduate School). Age was also dichotomized into two levels (<11 years old, ≥11 years).

Body mass index

Height and weight were measured in the NHANES mobile examination centers (MEC) by trained health technicians using a standardized protocol.[16] BMI was calculated based on measured height and weight (kg/m^2) and converted to BMI-percentile for age and sex using a Statistical Analysis System (SAS) program (CDCP sex-specific 2000 BMI-for-age growth charts for the U.S.).[17] BMI-percentile was categorized according to four groups: underweight BMI <5th

percentile, normal weight – BMI 5th to < 85th percentiles, overweight – BMI 85th to < 95th percentiles, and obese – BMI ≥ 95th percentiles. For some analyses, BMI-percentile was collapsed into two groups (underweight and normal, overweight and obese).

Perception of weight

Self-perception of weight was assessed as part of the Weight History questionnaire during the MEC interview. Proxy respondents were not used for this assessment. Participants were asked about their perception of their weight with the question: "Do you consider yourself now to be…?" with three response options: (fat or overweight, too thin, about the right weight). A variable was created for further analysis based on whether the respondents accurately perceived their weight according to their measured weight (accurate perceivers vs. inaccurate perceivers).

Weight-loss efforts

Frequency of weight loss efforts and methods used were assessed as part of the MEC interview with no proxy respondents. Participants were asked "In the past year, how often have you tried to lose weight? Would you say…" Response options were never, sometimes, or a lot. Frequency of trying to lose weight was dichotomized as never vs. sometimes and a lot. For those who responded sometimes or a lot, responses were assessed regarding various types of weight management methods that were used such as dietary changes (portion control, decreased intake of carbohydrates, calories, fat, sweets and junk food, increased intake of fruits/vegetables) and exercise.

Self-reported dietary intake

The 24-hour dietary recall data for the first day from the Total Nutrient Intakes dataset were used to report intake from foods and beverages for energy, protein, carbohydrate, total sugars, dietary fiber, and total fat and shortfall micronutrients (iron, calcium, and potassium).[18] The first dietary recall was collected in person in the MEC using five-step multi-pass interview method. Dietary recall interviews for participants age 8 years old were conducted with a proxy with the child present. The proxy assisted in reporting intake information. Interviews for participants aged 9-11 were conducted with the child present along with an adult familiar with the participant's intake to assist them in the dietary recall process. Participants aged 12-15 answered for themselves and no proxies or adults were present. The dietary interviews were conducted in Spanish or English with translators available if needed. Information from the Food Patterns Equivalents Databases (FPED)[19] for 2011 – 2012 were used to report food group information (daily total vegetable and fruit, refined and whole grains, fruit juice, added sugars, and potatoes).

Data analysis

Data analyses were conducted with SAS statistical software (version 9.4; SAS Institute Cary, NC) using SAS Survey Procedures to account for NHANES's complex, multistate, probability sampling design to ensure representativeness of the civilian, non-institutionalized U.S. population. Appropriate sampling weights were applied to account for the complex survey design. Descriptive statistics (frequencies and means) were used to characterize the demographic, anthropometric, questionnaire, and dietary intake variables. Standard errors were calculated to estimate population parameters. Within SAS Surveymeans and Surveyfreq

procedures, t-tests were conducted to test for differences in means for continuous variables and Chi-square tests were conducted to examine differences in prevalence for categorical variables by how often youth tried to lose weight (sometimes/a lot vs. never). The level of statistical significance was set at alpha = 0.05.

Results

Demographic characteristics and weight loss methods

The total sample (N = 1303) was evenly distributed by sex with slightly more than half (55.9%) under the age of 11 (Table 1). Non-Hispanic White and non-Hispanic Black participants each made up about one-fourth of the sample; Mexican-American and Hispanic participants made up 30.9%, and participants who identified as other races and ethnicities made up the remainder (16.7%). Slightly less than half (44.8%) of the participants resided in a household with ≤ $34,999 annual income. The household reference person's highest education level was a high school diploma for slightly less than half of the participants (48.2%). The majority of participants were at a weight categorized as underweight or normal weight (61%), whereas 39% were overweight or obese. The majority considered their weight to be about the right weight (73.9%). Of the total sample, 67.1% of participants accurately perceived their own weight status. For youth who reported trying to lose weight, methods include exercising (99.4%), eating less sweets and fatty foods (88.7%), skipping meals (45.3%), cutting back (33.4%), starving for more than 24 hours (23.1%) and dieting (21.6%).

Weight-loss efforts by demographic characteristics, body weight perception and weight status

No differences were observed in the frequency of trying to lose weight by age, sex ($p= 0.055$), or the education level of the household reference person (Table 1). Participants from households with an annual income ≤ $34,999 reported a higher frequency of trying to lose weight compared to the participants living in homes with greater annual family income ($p = 0.017$). Also, participants with an overweight or obese weight status were more likely to report trying to lose weight, compared to participants having an underweight or normal weight status ($p < 0.0001$). The results showed that 91.7% of the participants who perceived themselves to be "fat or overweight" reported trying to lose weight sometimes/a lot compared to less than half of participants who perceived themselves to be "about the right weight" (48.4%) or "too thin" (23.2%) ($p < 0.0001$). For participants who accurately perceived their weight status, 52.4% tried to lose weight sometimes/a lot, while 47.6% never tried to lose weight ($p = 0.006$). Inaccurate weight perception was more often observed among participants who tried to lose weight sometimes/ a lot versus those who never tried to lose weight. Race/ethnicity differences were observed for frequency of trying to lose weight ($p = 0.004$). The proportion of Mexican Americans and Hispanics who reported never trying to lose weight was less (40.4%) than those who reported trying to lose weight sometimes/ a lot (50.6%). The proportion of non-Hispanic Blacks who reported never trying to lose weight (45.3%) was also less than those who reported trying to lose weight sometimes/ a lot (54.7%). However, the proportion of non-Hispanic Whites and those from other races who reported never trying to lose weight was similar to the proportion who reported trying to lose weight sometimes/ a lot.

Actual weight and self-perception of weight

Among the total number of participants, 3.3% were classified as underweight, 58.9% as normal weight, 15.8% as overweight, and 21.9% as obese by actual BMI-percentile (Table 2). Of those classified as underweight, 37.2% considered themselves to be too thin and 62.8% considered themselves to be at a normal weight. For participants who were classified as normal weight, 85.2% considered their weight to be about right, 11.1% considered themselves to be too thin and 3.7% considered themselves to be fat or overweight. For the participants who were classified as overweight, 21.4% accurately perceived themselves to be overweight, whereas 76.7% considered themselves to be about the right weight and 1.9% considered themselves to be too thin. Of the participants who were classified as obese, 54.7% accurately perceived themselves as being overweight, 42.8% perceived themselves to be of normal weight and 2.1% perceived themselves as too thin.

Food group and nutrient intake by frequency of trying to lose weight

Energy intake was significantly lower for those who reported trying to lose weight sometimes/ a lot ($p = 0.009$) compared to those who reported never trying to lose weight (1928 kilocalories vs. 2089 kilocalories). For participants who reported trying to lose weight, carbohydrate ($p = 0.010$), refined grains ($p = 0.024$), sugar ($p = 0.048$), cholesterol ($p = 0.030$) and fat ($p = 0.014$) intakes were lower than those who reported never trying to lose weight. Those who reported trying to lose weight sometimes/a lot had a significantly lower sodium ($p = 0.049$) intake than those who reported never trying to lose weight. Intake of added sugars did not differ by frequency of trying to lose weight ($p = 0.057$). For participants who reported trying to

lose weight, whole grain intake was higher than those who reported never trying to lose weight ($p = 0.044$).

Table 1. Demographic and Physical Characteristics and Self-Perception of Weight of Survey Respondents by How Often Tried to Lose Weight[1]

		How Often Tried to Lose Weight[2]		
	All N = 1,303 N (%)	Sometimes/ a lot N = 702 N (%)	Never N = 601 N (%)	p-value[3]
Age (n=1303)				0.911
< 11 years	729 (55.9)	400 (54.9)	329 (45.1)	
≥ 11 years	574 (44.1)	302 (52.6)	272 (47.4)	
Sex (n=1303)				0.055
Boys	661 (50.7)	343 (51.9)	318 (48.1)	
Girls	642 (49.3)	359 (55.9)	283 (44.1)	
Race/ethnicity (n=1303)				0.004
Mexican-American and Hispanic	403 (30.9)	204 (50.6)	163 (40.4)	
Other	217 (16.7)	104 (47.9)	113 (52.1)	
Non-Hispanic Whites	310 (23.8)	154 (49.7)	156 (50.3)	
Non-Hispanic Blacks	373 (28.6)	204 (54.7)	169 (45.3)	
Annual family income (n=1228)				0.017
≤ 34,999	550 (44.8)	319 (58.0)	231 (42.0)	
≥ 35,000	678 (55.2)	338 (49.9)	340 (50.1)	
Education level of household reference person (n=1262)				0.112
High school grad/GED[4]	608 (48.2)	362 (59.5)	246 (40.5)	
Some college/college/grad school	654 (51.8)	333 (50.9)	321 (49.1)	
Weight status[5] (n=1254)				<.0001
Underweight/normal	765 (61.0)	297 (38.8)	468 (61.2)	
Overweight/obese	489 (39.0)	400 (81.8)	89 (18.2)	
How do you consider your weight? (n=1302)				<.0001
Fat or overweight	228 (17.5)	209 (91.7)	19 (8.3)	
Too thin	112 (8.6)	26 (23.2)	86 (76.8)	
About the right weight	962 (73.9)	466 (48.4)	496 (51.6)	
Accurate perception of weight[6] (n=1296)				0.0057
Accurate perception	869 (67.1)	455 (52.4)	414 (47.6)	
Inaccurate perception	427 (32.9)	246 (57.6)	181 (42.4)	

[1]Weighted percentage and row percent for All and row percent for How Often Tried to Lose Weight category.
[2]Assessed by the following questions and response options the past year, how often have you tried to lose weight? Would you say…" (never, sometimes, or a lot).
[3]p-value according to Chi-square tests (significance level = 0.05)
[4]GED – General Equivalency Diploma
[5]Weight status is based on BMI-percentiles from the Center for Disease Control and Prevention sex-specific 2000 BMI-for-age U.S. growth charts and weight categories.
[6]Accuracy = perception of weight status matches actual BMI category, inaccuracy = perception of weight status does not match actual BMI category

Table 2. Accuracy of Weight Perception by Actual BMI-Percentile Category (N = 1300)

Weight Perception	BMI status			
	Underweight N (%)	Normal N (%)	Overweight N (%)	Obese N (%)
Too thin	16 (37.2)	85 (11.1)	4 (1.9)	6 (2.1)
About the right weight	27 (62.8)	653 (85.2)	158 (76.7)	122 (42.8)
Fat or overweight	0 (0)	28 (3.7)	44 (21.4)	156 (54.7)
Total	43 (3.3)	766 (58.9)	206 (15.8)	285 (21.9)

[1]Weighted percentage and column percent for age for BMI status.
[2]Do you consider yourself now to be…? (fat or overweight, too thin, or about the right weight).
[3]Weight status is based on BMI-percentiles from the Center for Disease Control and Prevention sex-specific 2000 BMI-for-age U.S. growth charts and weight categories.

Table 3. Food Group and Nutrient Intakes by How Often Tried to Lose Weight[1]

Food Groups and Nutrients	All	How Often Tried to Lose Weight[3]		
	Mean (SE) N = 1303[5]	Mean (SE) Sometimes, a lot N = 702	Mean (SE) Never N = 601	p-value[4]
Energy (calories)	2005 (34.7)	1928 (55.2)	2089 (29.3)	0.009
Protein (grams)	71.0 (1.8)	69.3 (3.4)	72.8 (1.5)	0.194
Carbohydrate (grams)	270 (4.12)	260 (5.7)	280 (4.0)	0.010
Sugars (grams)	130 (2.9)	125 (3.1)	135 (3.6)	0.048
Fiber (grams)	14.7 (0.32)	14.4 (0.42)	14.9 (0.53)	0.235
Fat (grams)	74.1 (1.9)	70.5 (3.0)	78.2 (1.7)	0.014
Cholesterol (mg)	225 (8.3)	213 (14.6)	240 (10.7)	0.030
Calcium (mg)	1080 (21.9)	1077 (28.1)	1084 (41.3)	0.599
Iron (mg)	14.8 (0.45)	14.3 (0.61)	15.4 (0.70)	0.074
Sodium (mg)	3207 (79.2)	3099 (114.0)	3319 (85.7)	0.049
Potassium (mg)	2279 (33.9)	2229 (65.7)	2326 (62.6)	0.228
Total Fruit (daily servings)	1.11 (0.07)	1.15 (0.09)	1.04 (0.08)	0.527
Fruit Juice (cup eq.)	0.35 (0.03)	0.36 (0.04)	0.34 (0.03)	0.901
Total Vegetable (daily servings)	0.93 (0.05)	0.93 (0.05)	0.93 (0.07)	0.322
Potatoes (cup eq.)	0.27 (0.02)	0.28 (0.04)	0.27 (0.04)	0.106
Added Sugars (grams)	20.0 (0.66)	18.9 (0.78)	21.1 (0.85)	0.057
Refined Grains (servings)	6.4 (0.18)	6.1 (0.24)	6.6 (0.19)	0.024
Whole Grains (cup eq.)	0.72 (0.02)	0.66 (0.07)	0.81 (0.07)	0.044

[1]Standard error of the means as a measure of variance and the mean intake of certain foods, vitamins and nutrient groups.
[2]Standard error was assessed by variance divided by the square root of N.
[3]Assessed by the following questions and response options the past year, how often have you tried to lose weight? Would you say…" (never, sometimes, or a lot).
[4]p-value according to t-tests (significance level = 0.05)
[5] 29 participants did not answer the question, "In the past year, how often have you tried to lose weight? Would you say . . ."

Discussion

Actual Weight and Self-perception

This study examined demographic characteristics, weight perception, and food group and nutrient intakes associated with trying to lose weight among a large U.S. nationally representative sample of 8-11-year-old children and 12-15-year-old adolescents. Weight misperception was more common among overweight and obese than normal and underweight participants. Inaccurate perceivers were also more likely to try to lose weight overall (P = 0.0057). These findings were similar to an earlier report based on NHANES data from 2005-2010 for 8-15 year olds.[20] Both adolescent girls and boys who perceived themselves as overweight were likely to report engaging in behaviors to control their weight. In most age groups, accurate overweight perceivers were more likely to try to lose weight compared to inaccurate overweight perceivers. In addition, according to a study by Chung, Perrin and Skinner (2013), the recognition of overweight/obesity resulted in a 20% to 30% increase in the prevalence of weight loss efforts.[20] The current study based on NHANES data from 2011-2012 vs. 2005-2010 indicates that the ability for children and adolescents to accurately perceive weight status has not improved over time. Body weight misperception persists, indicating that continued efforts to address this problem are necessary.

Several other studies also produced similar results as the current study. The current study showed that inaccurate perception of weight status occurred in 32.9% of the participants who were trying to lose weight. Most (91.7%) of the participants who considered themselves fat or overweight reported trying to lose weight either sometimes or a lot. Ojala et al.[21] reported that children and adolescents in a cross-country study who had BMIs indicative of being overweight were more likely to try to lose weight. Overweight boys were 3.2 (Russia) to 10.9 times more

likely to try to lose weight compared to non-overweight boys. Overweight status in girls increased the odds of trying to lose weight from 2.3 times (Lithuania) to 8.3 times (Denmark). In all the countries included, overweight adolescents used weight control methods more often than their normal-weight counterparts for both sexes. The difference in weight control practices used between overweight and non-overweight adolescents was significant with overweight adolescents eating fewer sweets and consuming fewer soft drinks than their normal weight counterparts. In another study, Finnish adolescents aged 14 to 16 filled out questionnaires about their health.[22] Among the normal weight adolescents (based on measured weight) who were dissatisfied with their weight, 81% of girls and 48% of boys thought they were overweight. [22] Strauss[23] surveyed adolescents aged 12 to 16 years old and found that 52% of girls who considered themselves overweight were of normal weight status, while 25% of boys who considered themselves overweight were of normal weight status ($P < 0.001$). Self-perceived weight status was also associated with attempts at weight loss ($P < 0.001$). Cross-sectional data from 448 adolescents in Chicago Public Schools showed that 27.2% of adolescents (grade 5-7) underestimated their weight status, while 67.2% correctly perceived their weight status.[24] Logistic regression models showed that adolescents with BMIs ≥ 85th percentile (OR = 2.53-8.08), self-perceived themselves as obese (OR = 7.19-45.30) or expressed any type of body dissatisfaction (OR = 1.64-10.37) were more likely to try to lose weight.

Weight misperception can exist among children and adolescents if they do not understand the concepts of being overweight and obese. Overweight and obesity are highly stigmatized, which may lead to inaccuracy of weight perception based on several factors. These factors may include self-esteem, body satisfaction, trauma, environment, mental disorders, internalization of weight bias, and fear of gaining secondary sex characteristics.[10] In a 2018 study conducted

among German adolescents, 88.1% showed a bias of underestimation of the average female body size, while 3.8% showed overestimation through photographic-rating on the Stunkard Figure Rating Scale.[11]

Overall, more adolescents who were overweight or obese were motivated to try to lose weight in the current study. Providing education on healthy weight loss practices and providing support at the household, school, and community level are ways that health professionals can help adolescents with high BMIs lead healthy, appropriate lifestyles when centered around weight loss or maintenance. The ability to accurately perceive weight status may contribute to efforts among children and adolescents to try to lose weight.[10,20]

Food Group and Nutrient Intake by Frequency of Trying to Lose Weight

A comparison of food group and nutrient intakes of adolescents trying to lose weight and those not trying to lose weight can provide information about whether overall diet quality is compromised by dieting attempts. In the current study, sugars, fat, cholesterol, sodium and refined grain consumption was significantly lower for participants trying to lose weight sometimes/ a lot compared to those never trying to lose weight. Positive findings were also reported in another study where nutrient consumption by dieting females was compared to non-dieting females.[25] The dieting group had lower sugar ($P = 0.0001$), fat ($P = 0.0003$), and sodium intakes ($P = 0.0004$) while maintaining their fiber intake compared to the non-dieting group, consistent with healthy diets.[26,27] Youth from Ireland (4-19 years old) had higher consumption of whole wheat bread when on a diet compared to a non-dieting group ($P < 0.01$).[28] In another study, seventh grade boys wanting to lose weight consumed 0.8 more servings of fruits and vegetables a day ($P = 0.026$) compared to boys not wanting to do anything about their weight.[28]

Food group intake was only different for whole grain and refined grain intake among the youth in the current study by frequency of trying to lose weight. In a study, college students in low to middle income countries that were trying to lose weight avoided carbohydrates more often than those not agreeing that they were trying to lose weight ($P = 0.009$).[29] These results were consistent with the current study where total carbohydrate intake was higher as well as refined grain ($P = 0.024$) and whole grain ($P = 0.044$) consumption for the group of adolescents not trying to lose weight.

Studies on intake suggest that in groups of adolescents trying to lose weight, nutrient and food group data were not negatively affected. Therefore, adolescents trying to lose weight may be choosing more "healthy" food choices compared to the group of adolescents not concerned about trying to lose weight, indicating that nutrition education for those dieting may not be an urgent need. In support of this suggestion, children and adolescents from schools in Australia with lower intakes of fat and high energy snacks, and higher intake of vegetables were at lower risk of overweight and obesity, and therefore may have some knowledge of the guidelines for healthy eating ($P < 0.001$).[30]

Weight Loss Methods

In the current study, healthy and less healthy weight loss methods were reported to be used by adolescents, consistent with the findings of others. For example, other researchers have shown that adolescents trying to lose weight used the following less healthy methods: fasting (4-30%), vomiting (1-14%), diet pill or laxative usage (0-19%), and smoking (3-17%).[21] However, exercise and a lower intake of sweets were the top two weight loss methods reported among individuals in several studies.[21,31,32] Gabhainn et al. [27] reported that boys (age 9-11) who were

dieting were more likely to report current smoking compared to dieting girls, who reported more regular coffee and tobacco consumption as a means to lose weight.[27] An increase in exercise frequency to lose weight in the dieting group was observed only in girls aged 15-17 ($P < 0.0001$), suggesting that differences in weight loss methods may not be independent of sex. A variety of weight loss methods used in the last 3 months to influence weight status was reported by 1,542 German adolescents including exercising (58.0%), eating less during meals (34.8%), skipping meals (21.8%), fasting (15.3%), self-induced vomiting (2.8%), and taking diet pills or laxatives (1.7%).[10] In a Project EAT study from 2009, female teens who persisted in using healthy weight control behaviors improved dietary intake compared to those who did not report healthy weight control behaviors.[11] Healthy weight control persisters consumed significantly less fast food, had lower levels of total saturated fat intake, and consumed fewer sugar-sweetened beverages than those who did not report engaging in healthy weight control behaviors.[11] Therefore, weight loss and control methods may be indicative of dietary outcomes in children, adolescents, and teens. Girls with a strong bias toward underestimation of body size were more likely to report skipping meals and avoiding certain foods compared to girls without this bias.[10] Similar findings showed that Brazilian high school girls who perceived themselves to be overweight reported eating fewer calories and fatty foods (41.5%), refraining from eating for 24 hours or more (10.9%) and exercising (57.3%).[33] In these studies and the current study, the most common method used to lose or control weight was exercising, which is a healthy weight loss method. Exercise is also a method that is widely available, although unsafe neighborhood environments may inhibit exercise for some adolescents. Because more youth from lower income households were likely to try to lose weight compared to higher income households in

the current study, attention should be paid to providing safe and accessible exercise opportunities for youth.

Study Strengths and Limitations

NHANES data are based on large, nationally representative samples, which is a strength of this study. However, a smaller subgroup of 8-15 year olds from the 2011-2012 sample was used for analysis in the current study which led to a limited sample size and larger variance in the data.[34] Another limitation to the study is that it could not demonstrate cause and effect relationships because of its cross-sectional design. The assessment of weight misperception was completed using one question, "Do you consider yourself now to be . . .", with responses of, "fat or overweight, too thin, or about the right weight".[35] Finally, the assessment of actual weight status was completed based on BMI percentiles only.[36] Other measures of adiposity such as skinfold measurements and waist circumference could also have been used to assess actual weight status.

Implications for Public Health

Childhood and adolescence are crucial periods for physical growth and development and emotional maturity. Some weight gain is developmentally normal and healthy during puberty; however, excessive weight gain may contribute to chronic disease risk factors. Current research suggests that health and wellness programs for children are important. Although eating a healthy, balanced diet along with physical activity should be the focus of these programs, understanding that body weight perception may be distorted among children and adolescents has implications that could affect the perception of wellness. Current and new community- and school-based programs could be implemented to reach a large population of children and adolescents aged 8-

15 years. School health classes already focus on nutrition and physical activity with the goal of chronic disease prevention. Discussion of accurate body weight perception and body size acceptance are also topics that could be explored. Additionally, school nurses and teachers could use various approaches such as after school clubs, weight training programs, walking clubs with pedometers, cooking classes and other programs to meet the needs of children and adolescents. Schools and communities should play an active role in promoting accurate body images that will encourage healthy weight loss for overweight and obese youth to prevent obesity in adulthood and foster healthy lifestyle choices into adulthood.

Conclusions

In summary, distorted body image and certain demographic and physical characteristics are significant factors affecting whether children and adolescents attempt to lose weight. The demographic and physical characteristics that played a role included annual family income, race/ethnicity, weight status, and perception of weight status. Trying to lose weight impacted participant's food and nutrient choices and intakes. Intake of energy, carbohydrates, sugars, fat, cholesterol, sodium, and refined grains were all significantly higher for those who never tried to lose weight, compared to those who reported trying to lose weight sometimes or a lot. Children and adolescents who are overweight or obese should be encouraged by public health professionals to make healthy lifestyle choices around nutrition and physical activity in community, school and healthcare settings. Achieving a healthy body weight, along with accurate body weight perception should be at the core of education for healthy lifestyles beginning in childhood. Further implications for research include dichotomizing variables to see if a relationship between more than two variables could be found. Multivariate regression

analysis including demographic and annual family income variables in models could also be conducted to adjust for variables that could affect intake.

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